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(56) Documents cited

GB 2192320 A

EP 0124043 A1

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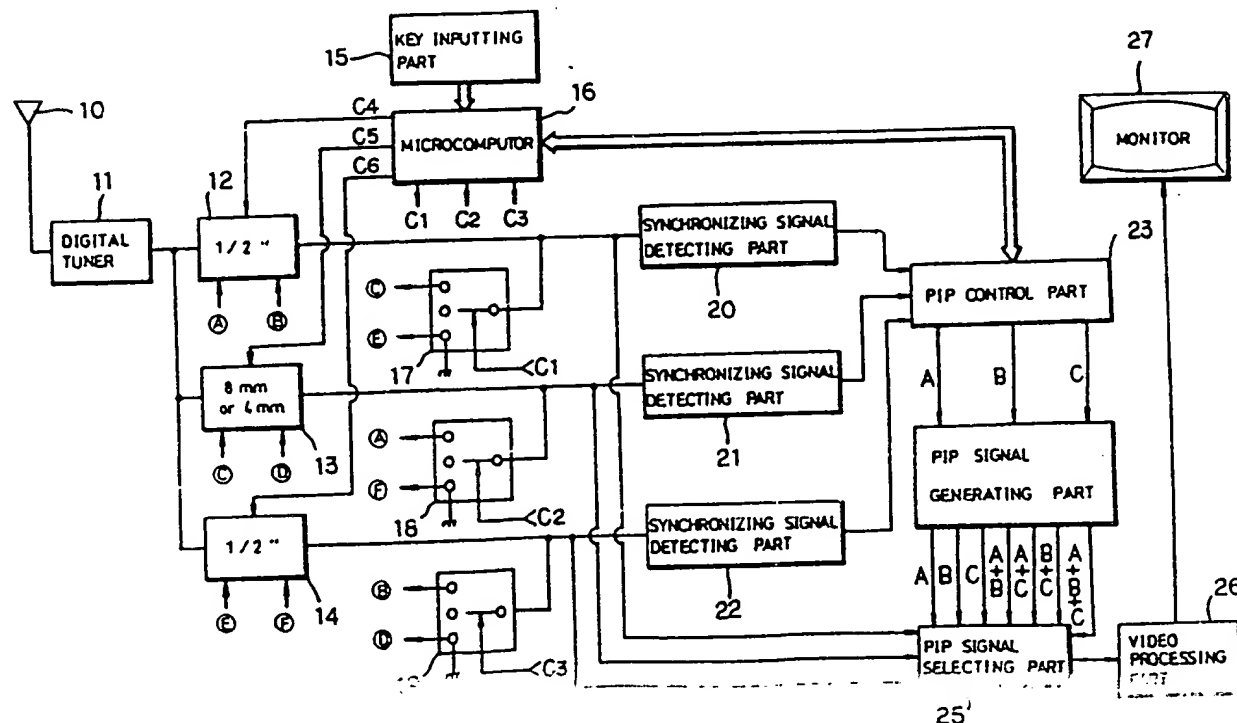
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(54) Video signal processing system

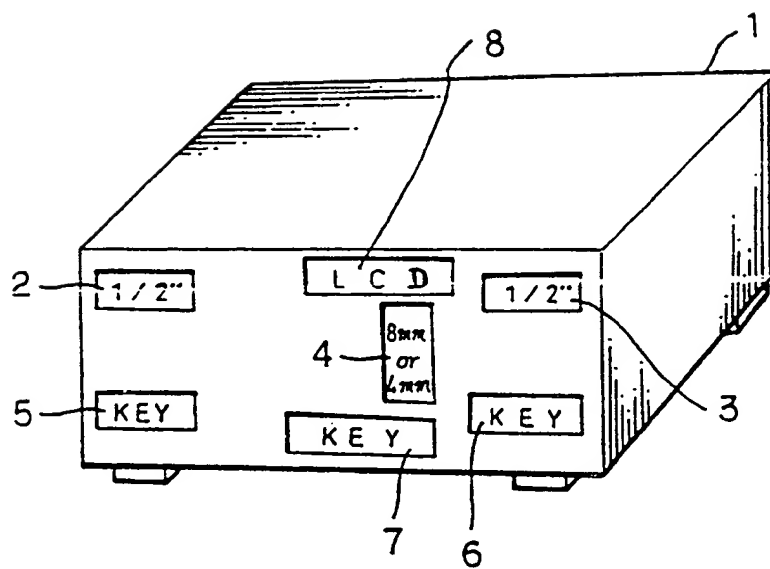
(57) A triple deck recording and reproducing system comprises three different video tape decks or two similar video decks 12, 14 and another different video deck 13 integrated together within a single video tape recorder, so that, when performing recording and reproducing, a main picture is displayed by selecting one of the video decks and another picture is displayed in the form of a PIP (Picture-In-Picture) from another of the video decks. Thus, the selected main and auxiliary pictures can be mixed with another deck, except these two decks, for dubbing recording, and then, a user can display all the signals reproduced by three decks in PIP mode, so as to compare the pictures with each other and display a plurality of different pictures as a particular effect. The system further comprises a switching means to enable the reproducing signal output of each deck to be fed to either of the other decks, and a mi.

FIG. 2



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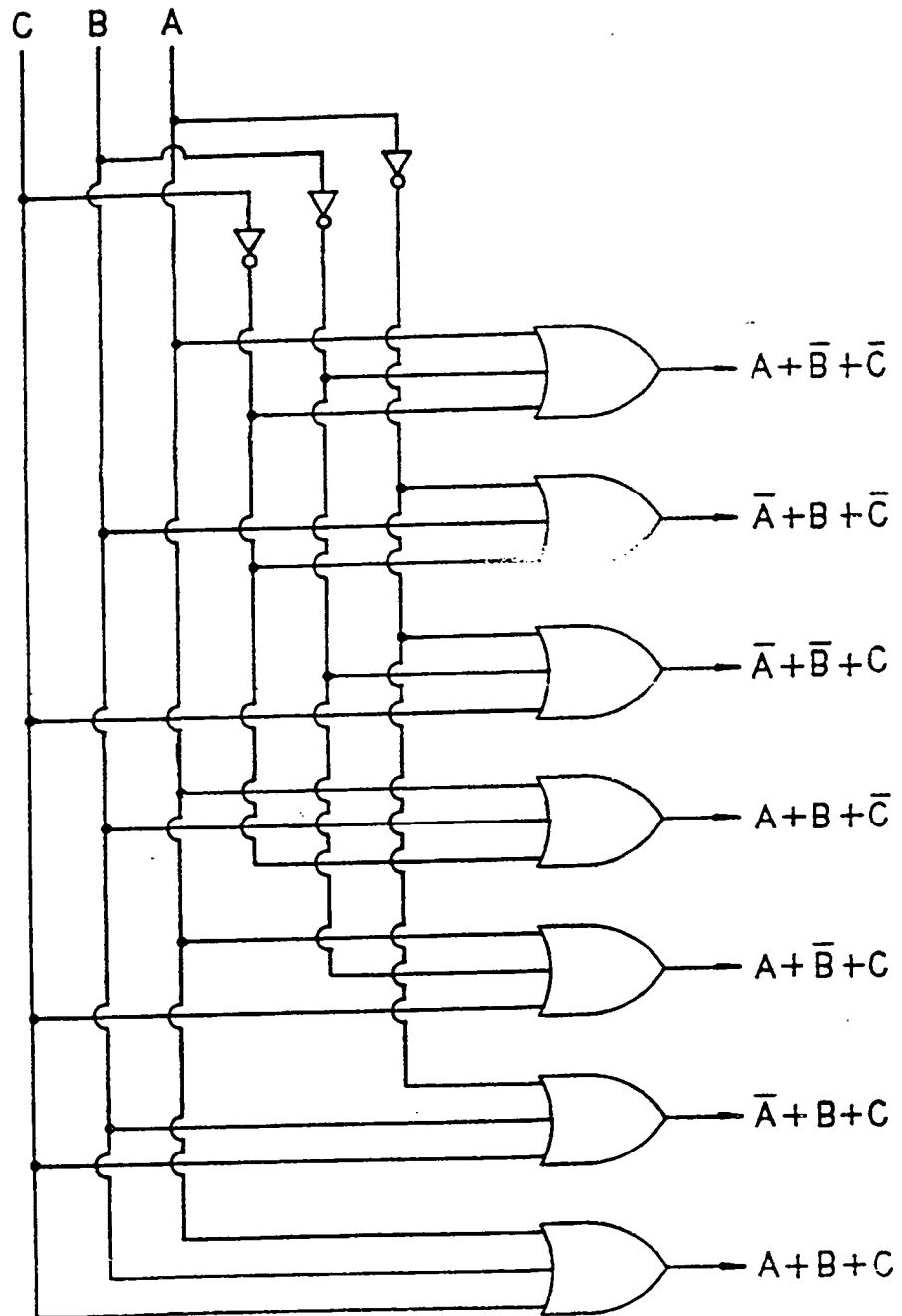
FIG. 1



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The diagram illustrates a video camera system architecture. At the top, a **KEY INPUTTING PART** (15) is connected to a **MICROCOMPUTER** (16). The microcomputer has control lines C1, C2, and C3 leading to three camera modules (12, 13, 14) and lines C4, C5, and C6 leading to three PIP control parts (17, 18, 19). Each camera module includes a **DIGITAL TUNER** (11) and a video input (A, B, or C). The PIP control parts (17, 18, 19) are connected to **SYNCHRONIZING SIGNAL DETECTING PARTS** (20, 21, 22) and **PIP SIGNAL GENERATING PARTS** (23, 24, 25). The generating parts output signals A, B, and C, which are then combined in the selecting parts (26, 27, 28) to produce $A+B+C$, $A+B$, $A+C$, and $A+C$ signals. These signals are fed into a **VIDEO PROCESSING PART** (29), which is connected to a **MONITOR** (30). The entire system is labeled 10.

FIG. 3



- 1 -

VIDEO SIGNAL PROCESSING SYSTEM

The present invention relates to video signal processing systems, and particularly to recording and reproducing systems.

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Generally, video tapes of a VHS size (12.65mm = 1/2-inch) can be used only in a video tape recorder of a VHS type, while 8mm or 4mm video tapes can be used only for 8mm or 4mm video tape recorders. Therefore, if a user using a VHS type video tape recorder has only 8mm video tapes, he cannot use the tape before he purchases an 8mm size video tape recorder additionally. Further, if a program on a VHS tape is to be edited or copied to 8mm tape, or if a program on an 8mm tape is to be edited or copied to VHS tape, two video tape recorders are required.

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Accordingly, there has arisen among consumers a demand for multi-function video tape recorders for copying or editing any kind of tapes such as VHS type or 8mm or 4mm size. In order to meet such a demand, double deck video tape recorders in which two video decks of VHS type or two different types of video decks are integrated within a single video tape recorder, have been introduced.

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However, in the case of such double deck video tape recorders, for example, an integrated double deck video tape recorder of VHS-8mm, recording is performed simultaneously both in a VHS type video deck (1/2-inch deck) and in an 8mm video deck. Further, the program of a particular channel on air can be recorded by either the VHS type or 8mm type deck, and at the same time a program can be reproduced by the other video deck. Further, a program recorded on a VHS tape can be edited and copied to 8mm

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tape, and inversely, a program on an 8mm tape can be also edited and copied to VHS tape.

Preferred embodiments of the present invention aim to provide a triple
5 deck recording and reproducing system in which two VHS type $\frac{1}{2}$ -inch video decks and a single 8 mm or 4 mm video deck are incorporated within a single video tape recorder, so that, when performing recording and reproducing by simultaneously installing two video decks of $\frac{1}{2}$ -inch or 8mm or 4mm within
10 a set, a main picture is displayed by a selected deck among the $\frac{1}{2}$ -inch and 8mm or 4mm decks, and the pictures of another video tape are displayed in the form of a PIP (Picture in Picture) among the 8mm or 4mm and $\frac{1}{2}$ -inch video decks.

One embodiment of the present invention comprises a triple deck
15 recording and reproducing system including a digital tuner for converting and processing RF signals received through an antenna into video signals, switching means for mutually organically controlling and using first, second and third video deck means for recording and reproducing broadcasting signals received through the digital tuner or external signals on or from a
20 magnetic recording medium, a first switch connected to an output terminal of the first video deck means for selectively supplying the reproduced signals of the first deck means to the second and third video deck means, a second switch connected to an output terminal of the second video deck means for selectively supplying the reproduced signals from the second video deck
25 means to the first and third video deck means, a third switch connected to an output terminal of the third video deck means for selectively supplying the reproduced signals from the third video deck means to the first and second video deck means, the first, second and third switches forming a switching

means, synchronizing signal detecting means for detecting the synchronizing signals in the video signal recorded on the magnetic recording media and reproduced from the first, second, and third video deck means, key input means provided with a plurality of keys for operating the switching means and the first, the second, and the third video deck means, a microprocessor (hereinafter, termed "MICOM") for generating control signals controlling the switching means and the video deck means according to the signals input through the key input means, and PIP signal generating means for controlling picture signals displayed on a monitor by inputting synchronizing signals detected during reproduction by the first, the second, and the third video decks.

According to a first aspect of the present invention, there is provided a triple deck video recording and reproducing system comprising:

a digital tuner for processing high frequency signals received through an antenna into video signals;

first, second and third driving mechanism means for recording or reproducing broadcast signals or other external signals received through said digital tuner, on or from magnetic recording media;

switching means including a first switch for selectively supplying the reproducing signals of said first driving mechanism means to one of said second and third driving mechanism means, a second switch for selectively supplying the reproducing signals of said second driving mechanism means to one of said first and third driving mechanism means, and a third switch for selectively supplying the reproducing signals of said third driving mechanism

means to one of said first and second driving mechanism means, said first to third switches being connected to output terminals of said driving mechanism means;

5 synchronizing signal detecting means for detecting synchronizing signals from the video signals of said magnetic recording media during a reproducing mode of said driving mechanism means;

10 key inputting means provided with a plurality of function keys for operating said driving mechanism means and said switching means;

15 a microprocessor for generating control signals to control said driving mechanism means and said switching means according to signals input from said key inputting means; and

20 PIP (Picture-In-Picture) signal generating means for displaying image signals on a monitor in the form of PIP by discriminating the existence or absence of respective synchronizing signals while driving said driving mechanism means.

25 Preferably, said driving mechanism means use at least one 1/2-inch video tape and at least one 8mm or 4mm video tape for recording and reproducing signals.

30 Preferably, said first driving mechanism means can simultaneously record signals of said magnetic recording media reproduced from said second and third driving mechanism means.

Preferably, said second driving mechanism means can simultaneously record signals of said magnetic recording media reproduced from said first and third driving mechanism means.

5 Preferably, said third driving mechanism means can simultaneously record the signals of said magnetic recording media reproduced from said first and second driving mechanism means.

10 Preferably, in the case where any two of said driving mechanism means are operated in a reproducing mode, a set of signals from one of said driving mechanism means may be used for a main picture and set of signals from the other of said two driving mechanism means may be used for an auxiliary picture on said monitor.

15 Preferably, in the case where all of said driving mechanism means are operated in a reproducing mode, one set of signals from one of said driving mechanism means is used for a main picture and sets of signals from the other two said driving mechanism means are used for auxiliary pictures on said monitor.

20 According to another aspect of the present invention, there is provided a recording and reproducing system comprising at least three decks and means for selectively establishing recording and reproducing paths between the decks, at least two of the decks being arranged to record and/or reproduce
25 video signals.

Such a system may further comprise any one or more of the features disclosed in the accompanying specification, claims, abstract and/or drawings, in any combination.

5 For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

10 Figure 1 is a schematic perspective view of one example of a triple deck recording and reproducing system according to the present invention;

 Figure 2 is a block diagram showing the triple video tape recording and reproducing system of Figure 1; and

15 Figure 3 is a detailed circuit diagram of a PIP signal generator as shown in Figure 2.

20 In Figure 1, the system comprises two video decks 2,3 each for receiving a respective 1/2-inch video tape, a video deck 4 for receiving an 8mm or 4mm video tape, key panels 5,6 for operating the video decks 2,3 of 1/2-inch respectively, a key panel 7 for operating the 8mm or 4mm video deck 4, and an LCD display 8 for displaying the operating state of the video decks 2,3,4.

25 The key panels can be located at one place close to one another and include a simultaneous recording key for editing.

Figure 2 illustrates the constitution of the triple deck video tape recorder. In Figure 2, a digital tuner 11 converts the RF signals of a VHF band (54~216MHz corresponding to channels 2 to 13) or an UHF band (470~890MHz corresponding to channels 14 to 83) which are received through an antenna 10 to video signals of about 4MHz. An output terminal of the digital tuner 11 is connected with a first, 1/2-inch video deck 12 for mounting a 1/2-inch video tape, a second, 8mm or 4mm video deck 13 for mounting an 8mm or 4mm video tape, and a third, 1/2-inch video deck 14 for mounting a 1/2-inch video tape. An output terminal of the first video deck 12 is connected with a first switch 17 which is operated by control signals C1 of a MICOM 16 upon manipulation of a key panel 15. An output terminal of the second video deck 13 is connected with a second switch 18 operating by control signals C2 of the MICOM 16. An output terminal of the third video deck 14 is connected with a third switch 19 for operating by control signals C3 of the MICOM 16.

The first, second, and third video decks 12,13,14 are respectively connected with synchronizing signal detecting parts 20,21,22 for detecting synchronizing signals during operation of the first, second, and third video decks 12,13,14. The output terminals of the synchronizing signal detecting parts 20,21,22 are connected with a PIP control part 23 for applying the detected synchronizing signals to the PIP control part 23. The PIP control part 23 is connected to a PIP signal generating part 24 for applying control signals A,B,C to the PIP signal generating part 24. The PIP signal generating part 24 is connected to a PIP signal selecting part 25 for selecting the outputs from the first, second, and third video decks 12,13,14 to apply to the PIP signal selecting part 25. The PIP signal selecting part 25 selectively or compositively provides the outputs from the first, second, and third video

decks 12,13,14, so that final video output signals are displayed on a monitor 27 through a video processing part 26.

Figure 3 is a detailed circuit diagram of the PIP signal generating part 24 as shown in Figure 2. In Figure 3, the PIP signal generating part 24 includes 7 NOR gates having 3 input terminals and inverters, so that 7 different outputs can be provided according to the control signals A,B,C of the PIP control part 23.

The first to third video decks 12, 13, 14 may all be 1/2-inch video decks for recording and reproducing 1/2-inch video tape, or two 1/2-inch video decks among three video decks and another video tape deck of 8mm or 4mm. Alternatively, they may comprise one 1/2-inch video tape deck of VHS type and two 8mm or 4mm video tape decks among the first to third video decks, and one among the three video decks may be replaced with a digital audio tape deck. The first to third switches 17, 18, 19 are analogue ones.

An example of operation of the above-described system will now be described in detail.

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First, in the case of recording into the second video deck 13 from the first video deck 12, if the user supplies the MICOM 16 with signals by manipulating the key panel 15, the MICOM 16 recognizes the signals and generates control signals C4,C5,C6 to put the first video deck 12 into a reproducing mode and the second video deck 13 into a recording mode, respectively. Then, the MICOM 16 turns off the third video deck 14 and generates only the control signal C1 at a high level so as to place the first

switch 17 at a contact point ㉔ and to turn off the second and third switches 18,19.

If the first switch 17 is placed at the contact point ㉔, the video signals
5 of the 1/2-inch video tape reproduced by the first video deck 12 are applied to
the second video deck 13 through the contact point ㉔ through the first switch
17. Under this condition, the synchronizing signal detecting part 20 detects
the synchronizing signals of the video signals reproduced by the first video
deck 12 to be supplied to the PIP control part 23. In this case, the PIP
10 control part 23 generates the control signals A,B,C which are supplied to the
PIP signal generating part 24. Then, because of the constitution of the PIP
signal generating part 24 as shown in Figure 3, only the selecting signal A is
placed at a high level to select only the output signals of the first video deck
12 when operating only the synchronizing signal detecting part 20, the output
15 signals passing via the PIP signal selecting part 25 and video processing part
26 to be displayed upon the monitor 27.

When operating the first and third video decks 12,14 under reproducing
and recording modes respectively, the user causes the first switch 17 to go to
20 contact point ㉕ by the control signal C1. Then, the video signals of the first
video tape inserted into the first video deck 12 are recorded on the third video
deck 14 and, at the same time, only the signals of the first video tape are
displayed on the monitor 27 as described above. On the other hand, in the
case of operating the second video deck 13 and the first video deck 12 under
25 reproducing and recording modes respectively, the second video switch 18 is
placed at a contact point ㉖ by a control signal C2 of the MICOM 16. Then,
the video signals of the 8mm or 4mm video tape are recorded on the first
video tape mounted on the first video deck 12. Under this condition, the

synchronizing signal detecting part 21 is operated to apply the synchronizing signals to the PIP control generating part 23, so that the PIP control generating part 23 recognizes the synchronizing signals received from the synchronizing signal detecting part 21 to apply to the PIP signal generating part 24. As shown in Figure 3, the PIP signal generating part 24 puts only the selecting signal B at a high level and applies it to the PIP signal selecting part 25, so that only the video signals of the 8mm or 4mm video tape are displayed on the monitor 27.

10 Further, in the case of operating the second video deck 12 and the third video deck 14 under reproducing and recording modes respectively, the user causes the second switch 18 to be placed at a contact point ⑤. Then, the video signals reproduced from the second video deck 13 are recorded on the third video deck 14 and simultaneously displayed on the monitor 27.

15 However, in the case of operating the third video deck 14 and the first video deck 12 under the reproducing and recording modes respectively, the user causes the third switch 19 to be placed at a contact ⑥ by the control signal C3 of the MICOM 16. Then, the video signals of the third video tape are recorded on the first video tape of the first video deck 12. Under this condition, the synchronizing signal detecting part 22 is operated to pass the synchronizing signals to the PIP control part 23, and the PIP control part 23 applies the synchronizing signals to the PIP signal generating part 24 by the synchronizing signals transferred from the synchronizing signal detecting part 22. Therefore, only the selecting signal C is put into the PIP signal selecting part 25 at a high level as shown in Figure 3, and then, only the signals of the third video tape are displayed on the monitor 27.

Meanwhile, in the case of carrying out recording on the video tape of the third video deck 14 using the video tape of the first video deck 12 for a main picture and using the video tape of the second video deck 13 for an auxiliary picture, the MICOM 16 puts the control signals C1,C2 at a low level. The video signals reproduced from the first video deck 12 are supplied through the contact point ④ of the first switch 17 to the terminal ⑤ of the third video deck 14, and the video signals reproduced from the second video deck 13 are supplied through the contact point ⑥ of the second switch 18 to the terminal ⑥ of the third video deck 14, so as to record them on the third video tape. Under this condition, the first video tape provides the main picture, and the second video tape provides the auxiliary picture. If the synchronizing signal detecting parts 20,21 are operated to apply signals to the PIP control part 23, the PIP signal generating part 24 generates A+B signals to the PIP signal selecting part 25 to display the signals output from the PIP signal selecting part 25 on the monitor 27 through the video processing part 26. Under this condition, the signals of the first video tape form the main picture and the signals of the second video tape form the auxiliary picture.

Meanwhile, in the case of operating the first video deck 12 and the third video deck 14 simultaneously in reproducing mode and the second video deck 13 in recording mode, the MICOM 16 puts the control signals C1,C2 at a high level and puts the control signal C3 at a low level. Then, the signals of the first video tape are supplied through the contact point ③ of the first switch 17 to a terminal ③ of the second video deck 13, and the signals of the third video tape are supplied through the contact point ④ of the third switch 19 to a terminal ④ of the second video deck 13, so as to display the first video tape image for the main picture and the third video tape image for the auxiliary picture on the monitor 27.

On the other hand, in the case of operating the second video deck 13 and the third video deck 14 in reproducing mode, and the first video deck 12 in recording mode, the MICOM 16 places all the control signals C1, C2 at a high level and the control signal C3 at a low level, with the result that the signals of the second and third video tapes are supplied through the contact point ① of the second switch 18 and the contact point ② of the third switch 19 to the terminals ①, ② of the first video deck 12 respectively. Consequently, the signals applied to the first video deck 12 are recorded on the first video tape to display the signals of the second video tape for the main picture and the signals of the third video tape for the auxiliary picture on the monitor 27.

If any two video decks are used in reproducing mode and the other is used in recording mode, the main and auxiliary picture signals can be obtained by the user's operating main picture and auxiliary picture function keys (not shown) of the key panel 15. That is, if the first and second video decks 12, 13 are used for the reproducing mode and the third video deck 14 is used for recording mode, the main picture signals of the monitor 27 are the signals of the first video tape, and the auxiliary picture signals are the signals of the second video tape. Alternatively, the main picture signals may be the signals of the second video tape, and the auxiliary picture signals the signals of the first video tape.

Meanwhile, in the case where the apparatus as shown in Figure 2 is operated for reproducing, the respective video decks can selectively be operated by opening all the first to third switches 17,18,19 under the control of the MICOM 16 and selectively applying the control signals C3,C5,C6 to the first, second, and third video decks 12,13,14 respectively. Further, if any two of the video decks are used for simultaneously reproducing as described

above, the main and auxiliary pictures can also be displayed on the monitor 27.

Further, in the case of reproducing from all three video decks simultaneously, if the signals are supplied to the MICOM 16 by manipulating the key panel 15, the MICOM 16 opens all the first to third switches 17~19 for controlling the control signals C1-C3 and the PIP signal generating part 24 generates the signals A+B+C in order to select all of the first to third video decks. Then, three sets of the signals of the three video tapes are all displayed on the monitor 27, and under this condition, the key panel 15 can be operated to display selectively one main picture and two auxiliary pictures.

Further, the illustrated video tape recorder system can record the respective television broadcasting channels selected by the digital tuner 11 and received through the antenna 10. The MICOM 16 puts the first, second, and third video decks 12,13,14 in the recording mode and opens all the first, second, and third switches 17,18,19 to record the broadcasting. In this case, the TV broadcasting is displayed on the monitor 27.

As another embodiment of the present invention, any one of the 8mm or 4mm video deck and 1/2-inch video decks may be replaced with a digital audio tape deck or a compact disc deck so as to be used for an audio-video system or for dub editing.

According to the above-described embodiment of the present invention, two 1/2-inch video decks and one 8mm or 4mm video deck are integrated within a single video tape recorder, and main and auxiliary pictures are formed so that the user can arbitrarily edit or display the pictures.

Particularly, when editing a picture photographed by a camcorder, a certain beautiful or necessary scene can be inserted and the user can display a single picture with all the signal reproduced from three video decks on a single screen to compare them or display a plurality of various pictures as a particular effect therefrom.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any

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accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A triple deck video recording and reproducing system comprising:

5 a digital tuner for processing high frequency signals received through an antenna into video signals;

first, second and third driving mechanism means for recording or reproducing broadcast signals or other external signals received through said
10 digital tuner, on or from magnetic recording media;

switching means including a first switch for selectively supplying the reproducing signals of said first driving mechanism means to one of said second and third driving mechanism means, a second switch for selectively
15 supplying the reproducing signals of said second driving mechanism means to one of said first and third driving mechanism means, and a third switch for selectively supplying the reproducing signals of said third driving mechanism means to one of said first and second driving mechanism means, said first to third switches being connected to output terminals of said driving mechanism
20 means;

synchronizing signal detecting means for detecting synchronizing signals from the video signals of said magnetic recording media during a reproducing mode of said driving mechanism means;

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key inputting means provided with a plurality of function keys for operating said driving mechanism means and said switching means;

a microprocessor for generating control signals to control said driving mechanism means and said switching means according to signals input from said key inputting means; and

- 5 PIP (Picture-In-Picture) signal generating means for displaying image signals on a monitor in the form of PIP by discriminating the existence or absence of respective synchronizing signals while driving said driving mechanism means.
- 10 2. A triple deck recording and reproducing system as claimed in claim 1, wherein said driving mechanism means use at least one 1/2-inch video tape and at least one 8mm or 4mm video tape for recording and reproducing signals.
- 15 3. A triple deck recording and reproducing system as claimed in claim 1 or 2, wherein said first driving mechanism means can simultaneously record signals of said magnetic recording media reproduced from said second and third driving mechanism means.
- 20 4. A triple deck recording and reproducing system as claimed in claim 1, 2 or 3, wherein said second driving mechanism means can simultaneously record signals of said magnetic recording media reproduced from said first and third driving mechanism means.
- 25 5. A triple deck recording and reproducing system as claimed in claim 1, 2, 3 or 4, wherein said third driving mechanism means can simultaneously record the signals of said magnetic recording media reproduced from said first and second driving mechanism means.

6. A triple deck recording and reproducing system as claimed in any of the preceding claims, wherein, in the case where any two of said driving mechanism means are operated in a reproducing mode, a set of signals from one of said driving mechanism means may be used for a main picture and set
5 of signals from the other of said two driving mechanism means may be used for an auxiliary picture on said monitor.
7. A triple deck recording and reproducing system as claimed in any of the preceding claims, wherein, in the case where all of said driving
10 mechanism means are operated in a reproducing mode, one set of signals from one of said driving mechanism means is used for a main picture and sets of signals from the other two said driving mechanism means are used for auxiliary pictures on said monitor.
- 15 8. A recording and reproducing system comprising at least three decks and means for selectively establishing recording and reproducing paths between the decks, at least two of the decks being arranged to record and/or reproduce video signals.
- 20 9. A system according to claim 8, further comprising any one or more of the features disclosed in the accompanying specification, claims, abstract and/or drawings, in any combination.
10. A recording and reproducing system substantially as hereinbefore
25 described with reference to Figure 1, Figures 1 and 2, or Figures 1 to 3 of the accompanying drawings.

Patents Act 1977**Examiner's report to the Comptroller under
Section 17 (The Search Report)**

Application number

9200373.0**Relevant Technical fields**

(i) UK Cl (Edition K) G5R (RGB, RAB, RAC); H4F (FGJ)

(ii) Int CL (Edition 5) G11B

Search Examiner

A J RUDGE**Databases (see over)**

(i) UK Patent Office

(ii) **ONLINE DATABASE: WPI, INSPEC**

Date of Search

13 APRIL 1992

Documents considered relevant following a search in respect of claims

ALL

Category (see over)	Identity of document and relevant passages .	Relevant to claim(s)
A	GB 2192320 A (SAMSUNG)	1-10
X; Y	EP 0124043 A1 (KANO)	8-10; 1-10
Y	JP 2222297 A (MATSUSHITA)	1-10
	SEE WHOLE DOCUMENT IN EACH CASE	

Category	Identity of document and relevant passages	Relevant to claim(s)

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